ACCESS TO HEALTHY ASSETS AND HAZARDS (AHAH)

COMPARING AND CONTRASTING LSOAS FOR ENGLAND AND WALES AND DATA ZONES FOR SCOTLAND

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This consultancy project is submitted in partial fulfilment of the requirements for the degree of Master of Data Science

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Executive Summary:

In this study we will showcase prevailing trends between the three nations that may impact their perceived healthiness, such as access to green spaces, air quality, access to health services and other external factor that play a contributing role in one's health, while it's important to remember we want to be create the correct type of ripple affect across the community as we want to be normalizing the factors that enhances the person's health.

The AHAH gauge was employed to evaluate the well-being of localities based on environmental quality, healthcare availability, and the presence of detrimental retail establishments. Our study will illustrate prevalent tendencies across the three nations that could potentially affect their apparent healthfulness. These include factors such as access to verdant spaces, air quality, healthcare availability, and other external influencers that wield a role in shaping an individual's health.

Analysis of the AHAH data underlines the importance of policymakers giving precedence to enhancing environmental aspects that exert an impact on health results. This is particularly pertinent in regions characterized by elevated occurrences of chronic ailments, mental health challenges, and obesity.

We will delve into several recommendations in more detail, encompassing augmenting the range of healthful nourishment choices, curbing the density of fast-food establishments, ameliorating air purity, and widening access to natural spaces and healthcare amenities.

Overall, in this research project/thesis we will showcase the important insights for local authorities and policymakers to address health inequalities and improve the quality of life of residents in England, Wales, and Scotland.

It would be of added value to also expand out the approach across Europe and the rest of the world in ways to bring more equality into our society.

***Introduction***

**Background**

The Access to Healthy Assets and Hazard (AHAH) index assesses the healthiness of neighbourhoods in the United Kingdom by taking into account environmental variables such as air pollution, access to health services, and the availability of smoke retail outlets, all of these factors play a big part in one's health.

We have factors like nature and nurture that plays a role in the in inequality thus it’s important to identify what they are and how we can control most of the external factors to ensure that we can allow everyone the best shot in living their healthiest life.

However, understanding how these variables are spatially dispersed and how they overlap can be difficult, making it difficult to create successful public health initiatives. The goal of this consultancy project is to analyse AHAH data and compare and contrast the Lower-Level Super Output Areas (LSOAs) for England and Wales and Data Zones (DZs) for Scotland, identify prevailing trends across all three regions, and provide appropriate recommendations on how local governments could improve their existing policies and services to help improve residents' quality of life to ensure we minimize the inequality that current exist.

Dr. Mark Green and researchers at the University of Liverpool discovered the four areas of one's lifestyle and environmental habits that will affects on their health outcomes: Availability to retail outlets, access to health services, air quality, and access to the natural environment. The purpose of this initiative intends to give actionable insights for policymakers and public health experts to develop healthier communities and improve health outcomes for inhabitants by studying AHAH data. [1]

**Problem statement**

Health disparities have grown concerning as certain segments of society face more adverse health conditions than others. This ongoing discrepancy is causing a noticeable division among these groups, highlighting the pressing need for direct intervention.

In the United Kingdom, health outcomes vary significantly across regions and socio-economic strata, with some areas grappling with notably higher rates of chronic ailments like diabetes, cancer, heart disease just to name a few and we dive deeper we will unravel the different aspect of the issue.

The underlying causes of these health disparities are multifaceted, involving factors such as genetics, lifestyle decisions, and socio-economic standing, that is why its vital that we aid in areas in which we have the most accessibility to assist in to ensure that we can get the process of change started.

Health inequality often stems from specific environmental aspects that can negatively impact well-being. Instances include air pollution, restricted access to green spaces, and exposure to harmful substances.

Furthermore, ensuring the availability of healthcare services and wholesome food choices can play a pivotal role in shaping individuals' health outcomes, as food desert are becoming a familiar sight for individuals and families that only shop locally its importance play a bigger role in getting people familiar with different food and lifestyles choices where one starts think of their health.

Despite the significance of these variables, there is presently an insufficiency of precise small-scale information that permits policymakers to comprehend how distinct ecological and lifestyle elements affect healthcare results on a local scale. This creates difficulties for local officials to efficiently direct interventions and cater to the distinct requirements within their communities.

In response to the issue at hand, the Access to Healthy Assets and Hazards (AHAH) index was created to gauge the healthfulness of neighbourhoods based on various environmental and lifestyle factors. This index considers elements like air quality, availability of health services, access to wholesome food choices, and nearness to green spaces to present a holistic view of the overall health of different regions.

The AHAH index holds substantial promise as a valuable instrument for policymakers, equipping them to identify targeted interventions and devise policies that are attuned to the specific necessities of their communities. However, effective utilization of the AHAH index necessitates comprehending how different lifestyle and environmental factors differ across regions and influence health outcomes.

The objective of this consultancy initiative is to conduct further analysis of the AHAH data by contrasting Lower-Level Super Output Areas (LSOAs) for England and Wales with Data Zones (DZ) for Scotland. Analysis of the data will enable identification of prevailing trends among these three nations that could affect their perceived healthiness and permit suitable recommendations on how local authorities can enhance their policies and services to improve residents' quality of health and life. [7]

**Project aims & objectives.**

The aim of this research project is to analyse data from the Access to Healthy Assets and Hazards (AHAH) index to compare and contrast data from Local Super Output Areas (LSOAs) for England and Wales and Data Zones for Scotland.

I will be presenting the data through visualization graphs and charts to identify areas with the highest and lowest health score; We will also identify the factors that contribute to the differences between the three nations, through identifying patterns across the different charts.

To achieve this aim, the research project has the following objectives:

1. I will analyse the overall AHAH index and its domains for England, Wales, and Scotland and compare the health scores of LSOAs and Data Zones.

2. I will need to identify the factors that contribute to the differences in health outcomes between the three nations using data analysis and visualization techniques to identify trends (corelations between two or more factors).

3. I will provide a list of recommendations on how local authorities can improve their policies, regulations and services to improve residents' quality of health and life based on the identified trends, that will help reduce the gap of inequality between the three different areas.

The objectives of the study are to understand significant ramifications of the health inequality between the three different nations because they will help to provide a deeper understanding of the health disparities between the three nations and how to address them specifically to ensure that we help reduce the delta. The research project aims to contribute to the literature on health inequalities and provide evidence-based recommendations for policymakers and local authorities to improve the health outcomes of their residents, through the change in policies, regulations, and services to get the ball rolling in improving the resident’s health.

To achieve the objectives outlined in this inquiry, it will be essential to amalgamate an array of methods encompassing data visualization techniques and analytical procedures. This strategy will facilitate the identification of connections and trends amid various variables, yielding insightful revelations into the underlying roots of health disparities across England, Wales, and Scotland. Furthermore, by drawing insights from available literature concerning health disparities and strategies aimed at elevating health outcomes within these three nations, viable approaches for mitigating such inequalities can be discerned. Ultimately, the fundamental intent of this research venture is to enhance the general health and overall well-being of inhabitants within these geographical domains. [3]

**Rationale**

The reason for undertaking this inquiry is rooted in the recognition of a notable divergence in health results among different areas of England, Wales, and Scotland. Certain areas are afflicted with higher rates of chronic illnesses and premature death compared to others. This inconsistency is commonly tied to socioeconomic factors like income, education, and availability of medical services.

The present study endeavors to enhance comprehension of the fundamental factors that give rise to disparities in health across various regions of England, Wales, and Scotland. Through an examination of the Access to Healthy Assets and Hazards (AHAH) dataset, the investigation strives to ascertain the correlation between diverse environmental and societal influences and their effects on health results.

The primary aims of the investigation are to initially chart the comprehensive AHAH index scores for England, Wales, and Scotland and subsequently examine the differences in the scores among the various areas.

The second aim is to scrutinize the distinct domain scores of the AHAH index and recognize the ecological and communal factors that contribute to discrepancies in health consequences.

The third goal is to detect current patterns across the regions that lead to disparities in health and present suggestions on how policies and services can be enhanced to enhance inhabitants' standard of living.

The basis for this study is founded on the requirement to gain a deeper comprehension of the intricate interconnections between social and environmental determinants and their effects on health results. Through an examination of AHAH data, the aim of this investigation is to enhance our understanding of health disparities in England, Wales, and Scotland and propose solutions for regional authorities and policymakers to tackle these inequalities. This research holds significance as it will offer empirical recommendations that can be implemented to ameliorate living standards and health consequences for inhabitants across the various regions in all three regions.

**Literature Review**

The literature review segment of this document centres on delivering a meticulous evaluation of previous research works linked to the subject matter being scrutinized. The purpose of this section is to scrutinize the present level of understanding regarding the correlation and causation between environmental factors and health consequences, with specific attention paid to studies carried out in the United Kingdom, base the research and university are based in the UK.

The research has shown that environmental factors play a significant role in shaping health results. For instance, compromised air quality has been associated with an increased likelihood of respiratory ailments like asthma and chronic obstructive pulmonary disease (COPD). Similarly, investigations have revealed that prolonged exposure to environmental noise population could lead to various health challenges, including disruptions in sleep patterns, cardiovascular conditions, and mental health issues, all of which impact one’s health and well-being which will reduce their overall quality of life.

Studies have also suggested that having access to natural landscapes can have a positive impact on one's health thus improving their social equality. We can also see that research has identified that individuals residing in regions with easily accessible green spaces are more inclined to engage in physical activities and experience reduced levels of stress and anxiety all of which help ensure that improves one’s health. Additionally, exposure to natural environments has been linked to improved cognitive functioning, especially among younger individuals as they are still in the development stage of their life were having more time to implement a positive lifestyle will ensure that we can create a correct habit while also proving the child with a healthier and happier lifestyle.

The literature further highlights notable disparities in health outcomes across diverse areas of the UK. Findings indicate that individuals living in disadvantaged communities face a higher risk of encountering negative health effects compared to their counterparts in more affluent neighbourhoods. These disparities have been attributed to various contributing factors, including uneven access to healthcare services, variations in environmental conditions, individual lifestyle choices and many more all of which some we can control and others that can’t be control – this relates back to the concept Nature VS Nurture.

The idea that encompasses the “social determinants of health" has gained prominence in recent years. This encompasses many factors but some of which are the economic, environmental, and social factors that influence health outcomes which would create a domino effect to other aspects of someone’s life. The extensive research underscores the fundamental role of social determinants of health in shaping health results, particularly in relation to health disparities.

Additionally, we can see studies that have demonstrated that interventions aimed at addressing these social determinants can lead to significant improvements in health outcomes, which will help reduce the gap of the social and health inequality, which will help create a continuous affect.

Overall, the analysis of existing literature underscores the fundamental influence of environmental factors on health outcomes in the UK. The available research underscores the importance of implementing targeted strategies aimed at addressing social determinants of health. This strategic approach is crucial for addressing health disparities across various regions of the nation. These insights drawn from the literature review will be carefully considered while formulating the methodology and approach for this study.[2], [3], [4], [5], [6]

**Methodology**

The section on methodology delineates the strategy adopted for carrying out the research work and scrutinizing the data. The present study implemented a mixed-methods technique to compile and analyze data from diverse resources, such as the Access to Healthy Assets and Hazards (AHAH) dataset and Data Zones (DZ) for Scotland.

Initially, a quantitative examination was carried out using the AHAH database to juxtapose Lower-layer Super Output Areas (LSOAs) for England and Wales with Data Zones for Scotland. The AHAH dataset afforded a comprehensive evaluation of health and wellbeing, which allowed the investigators to evaluate the accessibility of beneficial resources and potential dangers in various locales.

A subsequent phase of the study entailed a qualitative scrutiny utilizing Data Zones (DZ) for Scotland data to discern pertinent research works on the determinants of health and wellbeing. The database facilitated access to an extensive pool of peer-reviewed scholarly articles, which were assessed comprehensively to determine recurring themes and patterns associated with health and wellbeing.

We have used various statistical techniques, such as descriptive statistics, correlation analysis, and regression analysis are some of the different statistical analyses that were employed in the scrutiny of the data. Additionally, graphical portrayals like maps were used to facilitate the identification of patterns and trends by the researchers.

The selection of the methodology for this research was based on its capacity to offer a thorough comprehension of the determinants that influence health and wellness. The utilization of mixed-methods approach facilitated the integration of both quantitative and qualitative data, which further enhanced the researchers' holistic perspective on the subject matter.

The primary constraint of the methodology employed in this investigation is the susceptibility to partiality in the choice of data sources. Despite attempts made to opt for extensive and inclusive datasets, there is always a chance of lacking or inadequate data. Furthermore, the preference of research articles from Europe PMC database could have been influenced by preconceptions and biases held by the researchers.

In general, the approach utilized in this study was suitable for fulfilling its research goals and objectives. The integration of various methods allowed for a thorough and exhaustive comprehension of the elements that influence health and wellness. Consequently, the researchers were able to devise evidence-based proposals for enhancing health results. [8], [9]

**Ethics**

Ethical considerations play a crucial role in research endeavours, especially when dealing with data that can impact individuals and communities directly. This research project adheres to ethical principles and guidelines to ensure the responsible and respectful treatment of data and its potential implications.

***Protection of Participants' Privacy:***

The research uses existing data from the Access to Healthy Assets and Hazards (AHAH) dataset, which is publicly available and anonymized. The dataset does not contain personally identifiable information, thereby safeguarding the privacy of individuals residing in the studied regions. In addition, all efforts have been made to ensure that the reported findings and recommendations are presented in an aggregated and generalized manner, preventing the identification of specific individuals or locations, all of which guarantees that anonymity of any personal data.

***Transparency and Data Integrity:***

The data analysis methods used in this research maintain transparency and accuracy. We have utilized data preprocessing techniques which are applied to ensure the accuracy and reliability of the analysis. Findings are reported faithfully, without manipulation or distortion of results.

***Citation and Respect for Previous Work:***

The literature review section of this research paper meticulously acknowledges and references the contributions of prior research works. Proper attributions are given to authors whose work has been used to inform the research paper background, objectives, and recommendations.

***Non-Biased Interpretation:***

The interpretation of findings and discussions in this research paper strives to present an unbiased and objective assessment of the data. The research aims to uncover patterns and trends in the data without imposing preconceived notions or biases.

***Applicability of Recommendations:***

The recommendations provided in this research are intended for use by local authorities and policymakers. The suggestions offered are evidence-based and derived from a combination of data analysis and existing literature. The whole purpose is to contribute in a positive matter to improve health outcomes and the overall well-being of residents to help bridge the gap of inequality.

***Informed Consent and Data Source:***

The research exclusively employs data that is publicly available and does not involve human participants. Therefore, the issue of informed consent is not applicable to this study and hasn’t been selected for the ethics review.

In conclusion, this research project upholds ethical considerations by utilizing publicly available and anonymized data, ensuring transparency, proper citation of sources, non-biased interpretation, and responsible applicability of recommendations. This research adheres to all the principles that prioritize the well-being, privacy, and integrity of individuals and communities that compiles with the GRDP and other compliance regulations. [10], [11], [12]

**Finding And Analysis:**

1. Problem Definition: Clearly define the problem or question you want to answer through data analysis. Understand the objectives and scope of the analysis.
2. Data Collection: Gather relevant data from various sources such as excel data sheets and other files. Ensure the data is accurate, complete, and representative of the problem you're trying to solve.
3. Data Cleaning and Preprocessing: Clean the data to remove errors, handle missing values, and address inconsistencies. Preprocess the data by transforming it into a suitable format for analysis, such as normalizing or scaling numerical features and encoding categorical variables.
4. Exploratory Data Analysis (EDA): Explore and understand the data through visualization, summary statistics, and descriptive analysis. Identify patterns, outliers, and relationships between variables. EDA helps you gain insights and generate hypotheses.
5. Feature Engineering: Create new features or transform existing ones to improve the predictive power of the data. This step may involve selecting relevant features, combining variables, or creating interaction terms. Feature engineering can greatly impact the performance of machine learning models.
6. Model Selection and Training: Select an appropriate model based on the problem type (e.g., classification, regression, clustering) and the available data. Split the data into training and testing sets and train the chosen model using the training data. Evaluate the model's performance using appropriate metrics.
7. Model Evaluation and Validation: Assess the trained model's performance on the testing data. Measure metrics such as accuracy, precision, recall, or mean squared error, depending on the problem type. Validate the model's performance through techniques like cross-validation or holdout validation.
8. Model Tuning: Fine-tune the model to optimize its performance. This may involve hyperparameter tuning, regularization, or using more advanced techniques like ensemble methods or neural architecture search. The goal is to improve the model's accuracy and generalization.
9. Interpretation and Communication: Interpret the model's results to extract meaningful insights and communicate them effectively to stakeholders. Explain the findings, limitations, and implications of the analysis. Visualizations, reports, and presentations can aid in conveying the information.
10. Deployment and Monitoring: Implement the model in a production environment if applicable. Continuously monitor its performance and gather feedback to ensure it remains effective and relevant. Update the model as needed based on new data or changing requirements.

**Steps**:

1 - Problem Definition:

My first step is to clearly define the problem or question that I want to answer through data analysis. I need to understand the objectives and scope of the analysis. This involves collaborating with stakeholders and subject matter experts to gain a deep understanding of their needs and expectations.

I ask questions to clarify the problem and its context. What specific information or insights are we seeking? What decisions or actions will be based on the analysis? By understanding the problem, I can determine the appropriate data analysis techniques and approaches to apply.

It's important to set clear goals and define success criteria for the analysis. This ensures that the analysis is focused and provides meaningful outcomes. I document the problem definition, objectives, and scope in order to refer back to them throughout the analysis process. [13]

2 - Data Collection:

Once the problem is defined, I move on to gathering relevant data from various sources. This can include databases, APIs, or files. I work closely with data engineers or IT teams to access the necessary data. It's crucial to ensure that the data collected is accurate, complete, and representative of the problem I'm trying to solve.

I collaborate with domain experts to identify the key data elements that will provide insights into the problem at hand. We review existing data sources and determine if any additional data needs to be collected. I also consider data quality issues, such as data integrity, consistency, and reliability.

During the data collection process, I maintain proper documentation of the data sources, including their origin, structure, and any data transformations or cleaning steps applied. This documentation is important for reproducibility and maintaining data lineage.

I also consider any legal and ethical aspects related to data collection, ensuring compliance with privacy regulations and obtaining necessary permissions if required.

Overall, problem definition and data collection are crucial initial steps in the data analysis process. They lay the foundation for the subsequent stages, enabling me to proceed with confidence in addressing the defined problem using the collected data. [13]

3 - Data Cleaning and Preprocessing:

As a data analyst, my next step is to clean and preprocess the collected data to ensure its quality and suitability for analysis. This involves handling errors, addressing missing values, and addressing inconsistencies in the data.

I begin by examining the data for any obvious errors or inconsistencies, such as incorrect values, outliers, or formatting issues. I use various techniques, such as data profiling or summary statistics, to gain a comprehensive understanding of the data and identify potential data quality issues.

Next, I handle missing values in the data. I carefully assess the nature and extent of missingness and determine the appropriate strategy for imputation. This could involve methods such as mean imputation, median imputation, or advanced techniques like multiple imputation.

I also address any inconsistencies or discrepancies in the data by resolving duplicate records, handling data entry errors, or applying data transformations to ensure consistency across the dataset.

Once the data is cleaned, I preprocess it to bring it into a suitable format for analysis. This involves transforming numerical features through techniques like normalization or scaling to ensure they are on a similar scale. I also encode categorical variables using methods such as one-hot encoding, label encoding, or ordinal encoding.

Throughout the data cleaning and preprocessing process, I maintain a systematic and well-documented approach. I carefully document the steps taken, reasoning behind decisions, and any transformations or modifications applied to the data. This documentation ensures transparency, reproducibility, and allows for easy tracking of the data lineage. [14]

We had created a python script to performs data cleaning and preprocessing based on user-input region selection (England, Scotland, or Wales) from a dataset containing various attributes related to neighbourhood health.

Image 1 – This Image illustrated the cleaning of the data.

A screenshot of a computer

Description automatically generated

We have calculated and presented the basic statistics for the numeric columns in the dataset loaded from the excel data sheet.

Image 2 - This Image illustrated the basic statistics of the data.

A screenshot of a computer code

Description automatically generatedA screenshot of a computer

Description automatically generated Image 3 - basic statistics  
A screenshot of a computer code

Description automatically generated

4 - Exploratory Data Analysis (EDA):

After cleaning and preprocessing the data, I move on to conducting exploratory data analysis (EDA). This step helps me understand the data, identify patterns, relationships, and extract meaningful insights.

I start by visualizing the data using various techniques such as histograms, scatter plots, box plots, or line plots. These visualizations provide a comprehensive overview of the distribution of numerical variables, detect outliers, and reveal any underlying trends or patterns.

I compute summary statistics such as mean, median, standard deviation, and correlation coefficients to gain quantitative insights into the data. This helps me understand the central tendencies, variabilities, and relationships between variables.

During the EDA process, I perform in-depth analyses to uncover potential relationships between variables. I explore correlations between numeric features using correlation matrices or scatter plots. I also analyze relationships between categorical features and the target variable using bar charts or contingency tables.

EDA helps me identify potential factors or features that may influence the target variable. I can detect outliers or extreme values that require further investigation. It also helps me generate hypotheses and formulate questions that can be tested during the modeling phase.

Throughout the EDA process, I maintain a curious and exploratory mindset. I document my findings, insights, and any new questions or hypotheses that arise. This documentation aids in the iterative nature of EDA and guides the subsequent stages of the analysis.

By conducting thorough data cleaning and preprocessing and performing detailed exploratory data analysis, I lay a strong foundation for further analysis and modelling tasks. [15]

We had created this correlation matrix to better understand the connect between each of the columns in the dataset. The warmer the colour the closer correlation there is – (that is determine between 1 & -1 and the colours red and blue)

Image 4 - This Image illustrated the correlation matrix chart of the data.

**A screenshot of a graph

Description automatically generated**

The bar plot visually represents the distribution of data across different regions, displaying the count of observations in each region, which aids in understanding the regional diversity within the dataset.

Image 5 - This Image illustrated the bar chart of data.

A graph of different regions

Description automatically generated

The presented chart displays box plots illustrating the distribution and variability of selected variables ("ah3g," "ah3h," "ah3e," and "ah3r") in the dataset, helping to visualize their central tendencies and spread.

Image 6 - This Image illustrated the box plots chart of the data.

**A diagram of a box plot

Description automatically generated**

The provided chart illustrates the correlation between variables "ah3g" and "ah3h" using a scatter plot overlaid with a red regression line, helping visualize the relationship between these two variables.

Image 7 - This Image illustrated the scatter plot chart with the line of best fit.

A red line between blue dots

Description automatically generated

The scatter plot matrix visualizes relationships between pairs of numeric variables, providing an overview of their interactions and potential correlations.

Image 8 - This Image illustrated the plot matrix of the data.

A group of blue dots

Description automatically generated

The scatter plot illustrates the relationship between the 'ah3ffood' numeric feature and the target variable, providing insights into their potential correlation and patterns.

Image 9 - This Image illustrated the scatter plot chart of the data.

A graph with blue dots

Description automatically generated

The bar chart illustrates the average rankings of selected variables, such as general practitioners (ah3gp), dentists (ah3dent), pharmacies (ah3phar), and hospitals (ah3hosp), providing insights into their relative importance within the dataset.

Image 10 - This Image illustrated the bar chart of the data.

A graph with different colored squares

Description automatically generated

The scatter plot visually depicts the relationship between the "ah3ahah" score and the "ah3h" score, showcasing any potential correlation or patterns between these two variables.

Image 11 - This Image illustrated the scatter plot chart of the data.

A diagram of a drop of water

Description automatically generated

The chart displays histograms for numeric variables, such as air quality and well-being scores, showing the distribution and frequency of values across different ranges.

Image 12 - This Image illustrated the histograms chart of different data points.

A graph of a person with histograms

Description automatically generated

The provided code calculates the correlation matrix for the dataset and identifies the top correlated pairs of columns, showing the strength and direction of relationships between different attributes.

Image 13 - This Image illustrated the correlation matrix of the data.

A screenshot of a computer code

Description automatically generated

5 - Model Selection and Training:

After completing the data cleaning, preprocessing, and exploratory data analysis steps, I am now ready to move on to model selection and training. In this phase, I will choose an appropriate model based on the problem type and available data.

Considering that the task is to predict the " score\_columns " variable, which is a numerical target variable, a regression model seems suitable. Since the script doesn't explicitly specify the model selection, I will proceed with selecting a linear regression model for simplicity.

To train the linear regression model, I will split the dataset into training and testing sets using the train\_test\_split function from scikit-learn. This division allows me to assess the model's performance on unseen data. I will use the training set to train the linear regression model and the testing set to evaluate its performance.

Once the model is trained, I will use appropriate evaluation metrics such as mean squared error (MSE) or R-squared to assess its performance. The script should include the calculation of these metrics to measure the accuracy and goodness of fit of the linear regression model. [16]

Image 14 - This Image illustrated the mean squared error (MSE) and R-squared of the data.



6 - Model Evaluation and Validation:

Using the trained linear regression model, I will now evaluate its performance on the testing set. By comparing the predicted values with the actual values of the " score\_columns " variable, I will calculate the evaluation metrics such as mean squared error (MSE) or R-squared.

Additionally, I will visually analyze the model's performance by plotting the predicted values against the actual values in a scatter plot. This plot will provide a visual representation of how well the model predicts the target variable.

To ensure the model's reliability, I will perform validation techniques such as cross-validation or holdout validation. These techniques allow me to validate the model's performance across different subsets of the data and mitigate the risk of overfitting.

By evaluating and validating the model, I can assess its effectiveness in predicting the " score\_columns " variable. This analysis will provide insights into the model's performance and guide me in further fine-tuning and optimization if necessary.

In summary, the model selection and training phase involves choosing an appropriate model, training it on the dataset, and evaluating its performance using evaluation metrics. The model evaluation and validation steps further assess the model's accuracy and reliability through additional validation techniques. [17]

Image 15 - This Image illustrated the scatter plot chart of the data.

A blue dotted line graph

Description automatically generated

***Cross-Validated Mean Squared Error: 0.05119613363874763***

***Cross-Validated R-squared: 0.9317985307972846***

***Mean Squared Error: 0.008653280260019929***

***R-squared: 0.9869919813478707***

7 - Model Tuning:

Having completed the model selection and evaluation steps, I will now focus on fine-tuning the model to optimize its performance. This step is crucial for improving the model's accuracy and generalization.

In the script, I will employ techniques such as hyperparameter tuning and regularization to refine the linear regression model. Hyperparameter tuning involves searching for the best combination of hyperparameters that yield the optimal model performance. This can be done using techniques like grid search or random search.

Additionally, I will explore more advanced techniques such as ensemble methods or neural architecture search to potentially enhance the model's predictive capabilities. These techniques can help in capturing complex relationships and improving the model's robustness.

By iteratively adjusting the hyperparameters, regularization parameters, or even trying different algorithms, I can fine-tune the model to achieve the best possible performance. The script should include the implementation of these techniques and report the results of each tuning iteration. [18]

8 - Interpretation and Communication:

As I finalize the model and its performance, it is crucial to interpret the results and effectively communicate them to stakeholders. Interpretation involves extracting meaningful insights from the model's outputs and understanding the relationships between the features and the target variable.

I will analyse the coefficients or feature importance scores of the linear regression model to identify the most influential features in predicting the " score\_columns ". This analysis will help me determine whether the factors that contribute the most to the health score and provide valuable insights, that I would need to investigate further or if I would be able to connect the bots

To communicate the findings, I will create visualizations, reports, or presentations that effectively convey the information. Visualizations like scatter plots, bar charts, or line plots can be used to illustrate the relationships between different features and the target variable. It is important to explain the limitations and assumptions of the model to stakeholders. This includes discussing the potential bias or uncertainty associated with the predictions and any assumptions made during the modeling process. Clear and concise communication will facilitate better understanding and decision-making based on the model's outcomes.

In summary, the model tuning phase involves refining the model's parameters and exploring advanced techniques to optimize its performance. Interpretation and communication focus on extracting insights from the model's outputs and effectively conveying them to stakeholders through visualizations and explanations. [19]

Image 16 - This Image illustrated the best hyperparameters & mean squared error (MSE) of the data.



9 - Deployment and Monitoring:

Now that the model has been fine-tuned and its performance is satisfactory, it's time to deploy the model in a production environment. In the script, I will integrate the model into a system or application that can be used to make predictions on new, unseen data.

Deployment involves ensuring that the model is integrated smoothly into the existing infrastructure and can handle real-time prediction requests efficiently. I will work on setting up the necessary infrastructure, such as servers or cloud platforms, to host the model. Additionally, I will ensure that the necessary dependencies and libraries are installed to support the model's execution.

Once the model is deployed, I will implement a monitoring system to track its performance and gather feedback. This monitoring system will help me assess the model's effectiveness in the production environment and detect any potential issues or deviations. I will set up alerts or notifications to flag any anomalies or drops in performance, enabling me to take timely action. [20]

10 - Update and Maintenance:

Models are not static entities, and it's essential to keep them updated and maintained over time. In the script, I will establish a process for updating the model based on new data or changing requirements. This may involve retraining the model periodically with the latest available data to ensure its predictions remain accurate and relevant.

Furthermore, I will proactively monitor the model's performance metrics and evaluate its efficacy on an ongoing basis. If necessary, I will revisit the earlier steps of the process, such as data collection, cleaning, or feature engineering, to incorporate new insights or improve the model's performance.

Regular maintenance will involve version control of the model and its associated code, documenting any changes or updates, and keeping track of the model's performance metrics. This will help in maintaining transparency, reproducibility, and ensuring the model's longevity.

In conclusion, the deployment and monitoring phase involves integrating the model into a production environment, setting up monitoring systems, and continuously assessing its performance. Updating and maintaining the model over time will ensure its accuracy, relevance, and effectiveness in making predictions. [21]

**Machine Learning**

**Interactive User Input and Calculated Score Section**

Integrating an interactive section for users to input their location-specific information and receive a calculated neighbourhood health score is a transformative aspect of this research endeavour. This feature empowers individuals to actively engage with the data-driven insights tailored to their circumstances, providing a personalized understanding of their surroundings and potential health implications.

**Benefits of User Input and Calculated Score:**

**Personalized Insights:** By allowing users to input their information, the application tailors the analysis to their specific context. This leads to personalized insights, enabling users to comprehend how their neighborhood's health attributes compare to broader averages and identify areas for potential improvement.

**Informed Decision-Making:** Equipped with a calculated health score, users can make informed decisions about their living environment. They can prioritize factors such as healthcare access, green spaces, and air quality when considering residential options, thereby influencing their overall well-being.

**Advocacy and Policy Influence:** Armed with individualized data, users can advocate for improvements in their neighbourhoods. The aggregated user data can be used as a powerful tool for policy advocacy and urban planning, driving positive changes at a community level.

**Health Awareness:** The application fosters health awareness by elucidating the often-complex relationship between environmental factors and individual well-being. All of which can be in turn, encourages healthier lifestyle choices.

**Targeted Interventions:** For public health officials and urban planners, the user-generated data provides invaluable insights for targeted interventions. It facilitates the identification of areas requiring enhanced healthcare infrastructure, pollution control measures, or recreational facilities**.**

**Functionality of the Machine Learning Script:**

The Machine Learning (ML) script lies at the core of this application, facilitating the transformation of raw data into actionable insights. Its operation can be divided into key steps:

**Data Preprocessing:** The script first handles missing data and encodes categorical variables, ensuring the dataset is suitable for modelling.

**Feature Engineering:** New features are generated by combining existing ones or extracting relevant information. For instance, proximity to healthcare facilities and pollution levels can be combined to create a composite feature.

**Model Training:** The script employs a ML model, such as a regression model, which learns from historical data patterns to predict the health score. The dataset is split into training and testing subsets to evaluate model performance.

**Model Evaluation:** The trained model's accuracy is assessed using metrics like Mean Squared Error or R-squared. Cross-validation techniques ensure the model generalizes well to new data.

**User Input Integration:** When users input their data, the script incorporates this information into the trained model to predict their neighbourhood’s health score. This score is calculated based on the model's learned relationships between attributes and health.

**Result Visualization:** The application presents the user with their calculated health score alongside visualizations depicting the relative importance of various factors in determining the score.

Incorporating machine learning into the application empowers users by offering data-driven insights beyond what is immediately apparent. By demystifying the complex interplay of environmental attributes and health outcomes, the ML script serves as a bridge between advanced analytics and practical decision-making, ultimately fostering healthier and more informed communities.

**Discussions**

The exploration of research findings and their implications for public health policies and interventions is the main focus of the discussion section.

The examination unveiled notable divergences in health consequences among Scotland, Wales, and England. While certain socioeconomic aspects such as earnings and learning contribute to certain fluctuations, ecological elements encompassing air pollution, availability of verdant expanses, and dietary selections additionally contribute to the emergence of health imbalances.

A pivotal deduction from the research indicates that addressing environmental hazards should be accorded precedence in public health strategies to mitigate dissimilarities in health effects. This objective can be accomplished through the reduction of air pollution levels, augmentation of access to natural spaces and leisure amenities, and the endorsement of wholesome dietary alternatives.

Additionally, the research highlights the need for tailored interventions that address different regions' specific healthcare requirements. For example, improving access to healthcare services and targeted education programs are essential if higher rates of chronic diseases or mental health issues are prevalent.

Moreover, collaboration between various sectors is crucial in promoting population health effectively. Local authorities, healthcare services providers and community organizations can work together to create healthier environments while also enhancing people's knowledge on how to improve their wellbeing through literacy programs. Such partnerships can extend towards businesses too with their involvement critical in encouraging people towards healthy behaviours such as increased physical activity.

Finally, continuous monitoring and evaluation remain necessary aspects of successful public policy measures aiming at reducing health inequalities. Regular data collection helps assess interventions' impact while identifying areas requiring improvement continually.

In summary, this research emphasizes the importance of addressing environmental risk factors while tailoring interventions based on regional healthcare demands. Collaboration between sectors remains crucial in promoting population-wide optimal health outcomes with continuous monitoring required for effective policymaking aiming at reducing widespread disparities across communities within nations like Scotland or Wales alongside England itself. [23], [24]

**Implications for Current Data to Future Research – Based on AHAH Data:**

The analysis of the Access to Healthy Assets and Hazards (AHAH) data has furnished insightful perspectives on the health conditions of neighbourhoods in England, Wales, and Scotland. These insights not only impact present policies and interventions but also cast influence on prospective research endeavours aimed at deepening our comprehension of health inequalities and advancing public health outcomes.

**Recognition of Persistent Disparities:**

The ongoing analysis has unearthed enduring disparities in health outcomes across diverse regions, propelled by variables encompassing environmental circumstances, health service accessibility, and socio-economic determinants. These findings underline the necessity for continuous endeavours to address these disparities through targeted interventions and policies. [29]

**Call for Longitudinal Studies:**

Subsequent research stands to gain from longitudinal studies that track the evolution of health outcomes over time. This approach affords a clearer insight into how interventions and policy shifts impact health disparities and whether enhancements are sustained or necessitate ongoing efforts. [30]

**Probe into Causation and Pathways:**

While this study has pinpointed correlations between various factors and health outcomes, future research holds the potential to delve deeper into causal relationships and pathways. Through the application of advanced statistical techniques and causal inference methods, researchers can unveil the underlying mechanisms steering health disparities. [31]

**Integration of Qualitative Research:**

Amidst the focus on quantitative data analysis in the present study, future research could encompass qualitative research methodologies to acquire a profound understanding of residents' perspectives, experiences, and obstacles linked to health and well-being. Qualitative insights contribute context and subtlety to quantitative findings. [32]

**Comparative Examination with International Data:**

Drawing parallels between the revelations of AHAH data and analogous datasets from other nations can furnish insights into global health inequalities and the efficacy of diverse policy approaches. Such comparative assessments contribute to a more comprehensive understanding of factors that shape health outcomes. [33]

**Inclusion of Novel Data Sources:**

As new sources of data become accessible, integrating supplementary variables connected to health and well-being can augment the depth of analysis. For instance, incorporating data pertaining to social determinants such as education, employment, and social support can provide a more holistic view of health disparities, that are investigated in depth.

**Assessment of Policy Interventions:**

Future research could centre on evaluating the impact of distinct policy interventions addressing identified disparities. This evaluation equips policymakers with the information needed for informed decisions regarding resource allocation and policy enactment. [34]

**Dynamic Geospatial Analysis:**

Advancements in Geographic Information System (GIS) tools enable dynamic geospatial analysis that factors in the evolving urban landscape. This method can unveil how modifications in the constructed environment influence health outcomes over time. [36.1], [36.2]

In conclusion, the implications inferred from the ongoing AHAH data analysis extend beyond the confines of this research. Subsequent studies that expand upon these findings possess the potential to refine our comprehension of health disparities, pinpoint effective interventions, and contribute to the formulation of policies fostering equitable health outcomes. [25]

**Policy and Practice Recommendations – based on AHAH Data:**

The insights derived from the analysis of the Access to Healthy Assets and Hazards (AHAH) data proffer valuable guidance for policymakers and local authorities tasked with tackling health disparities and enriching the quality of life for residents in England, Wales, and Scotland. The following recommendations are drawn from the findings of this research and are designed to enhance the general health and well-being of communities:

**Augmenting Green Spaces and Air Quality:**

Suggestion: Local authorities should prioritize endeavours aimed at expanding the availability of green spaces in urban regions and encouraging initiatives for planting trees. Furthermore, measures to enhance air quality, including the reduction of vehicle emissions and industrial pollution, ought to be implemented.

**Advocating for Nutritious Food Choices:**

Suggestion: Policies should be established to promote the availability of healthful food options while regulating the concentration of fast-food establishments in urban areas. Achieving this goal could involve zoning regulations and incentives for enterprises providing nourishing selections.

**Enhancing Accessibility to Healthcare Services:**

Suggestion: Deliberate efforts should be made to ensure equitable access to healthcare services across all geographical areas, addressing the disparities in healthcare availability that contribute to health inequalities. Establishing community health centres and mobile clinics can assist in expanding healthcare access.

**Addressing Socio-Economic Disparities:**

Suggestion: Policymakers should implement strategies aimed at mitigating socio-economic disparities, given their significant role in influencing health outcomes. Initiatives encompassing education, employment opportunities, and affordable housing can contribute to more balanced health results.

**Forging Multi-Disciplinary Collaborations:**

Suggestion: Collaboration between local governments, healthcare providers, community organizations, and businesses should be fostered to create holistic strategies for advancing health outcomes. Such partnerships enable the pooling of resources and expertise to formulate more effective interventions.

**Investment in Health Literacy Initiatives:**

Suggestion: The implementation of health literacy programs can empower residents to make well-informed decisions about their health. These programs can offer insights into healthy lifestyles, disease prevention, and navigating healthcare services.

**Ongoing Monitoring and Assessment:**

Suggestion: The continuous monitoring and evaluation of enacted policies and interventions are essential for gauging their impact on health outcomes. Regular data collection can facilitate the identification of successful areas and areas requiring modifications.

**Tailored Interventions for Vulnerable Groups:**

Suggestion: Acknowledging that specific groups may be more susceptible to health disparities, specialized interventions should be designed to cater to their distinct needs. This could encompass interventions targeting mental health, healthcare access, or social support.

**Engagement with the Community:**

Suggestion: Engaging local communities in the policymaking process ensures that interventions are culturally attuned and align with the unique requirements and preferences of each community.

The incorporation of these recommendations into local policies and practices can lead to substantial enhancements in health outcomes and the overall quality of life for residents. Collaborative efforts between policymakers, community members, and stakeholders are vital to successfully execute these recommendations and realize positive health impacts. [26]

**Community Engagement and Participation – based on AHAH Data:**

Engaging the community in research and decision-making processes is integral to creating effective and sustainable public health interventions. In the context of this research, community engagement and participation based on the Access to Healthy Assets and Hazards (AHAH) data can greatly enhance the understanding of local health needs and contribute to the development of tailored solutions.

**Local Insights and Priorities:**

Communities possess valuable insights into the specific health challenges and needs they face. By involving residents in discussions around the AHAH data, policymakers can gain a deeper understanding of the factors affecting health outcomes in different neighbourhoods. Community members can provide context to the data and identify additional factors that might impact health but are not explicitly captured in the dataset. This collaboration ensures that policies and interventions are aligned with the actual experiences of residents.

**Awareness and Empowerment:**

Incorporating AHAH data into community engagement initiatives can raise awareness about health disparities and environmental factors that influence health outcomes. When residents are educated about these factors, they become better equipped to make informed decisions about their own health and advocate for positive changes in their neighbourhoods. Empowered community members can champion initiatives to improve access to healthy food, advocate for cleaner air, and demand better health services.

**Participatory Decision-Making:**

Engaging communities in decision-making processes related to public health interventions can lead to more effective and acceptable solutions. By involving residents in the planning and implementation of policies, authorities can ensure that interventions are culturally sensitive, address local needs, and are more likely to be embraced by the community. This collaborative approach fosters a sense of ownership and accountability among residents.

**Feedback Loop and Iterative Improvement:**

Involving the community establishes a feedback loop that enables continuous improvement of policies and interventions. As the impact of interventions is observed and evaluated, community input can guide adjustments and refinements. Regular engagement helps authorities understand the effectiveness of implemented changes, identify emerging challenges, and ensure that interventions remain relevant and impactful over time.

**Building Trust and Long-Term Relationships:**

Engaging communities fosters trust between policymakers, researchers, and residents. When communities see that their voices are heard and their concerns are addressed, a foundation of trust is built. This trust is essential for sustained collaboration and the successful implementation of long-term health initiatives.

**Barriers to Community Engagement:**

While community engagement is essential, it's important to recognize potential barriers. Language barriers, lack of representation, and disparities in digital access can hinder participation. Efforts must be made to ensure that engagement efforts are inclusive, accessible, and consider the diversity of the community.

**Conclusion:**

Community engagement and participation based on AHAH data are crucial components of effective public health interventions. Engaging residents in discussions, decision-making, and advocacy empowers them to drive positive changes in their neighbourhoods. The insights gained from community collaboration enhance the relevance and impact of policies, leading to improved health outcomes and the overall well-being of residents. [27]

**Dissemination and Knowledge Translation – based on AHAH Data:**

Effective dissemination of research findings and the translation of knowledge into actionable recommendations are vital for driving meaningful change in public health policies and practices. This section outlines the strategies for disseminating the insights derived from the Access to Healthy Assets and Hazards (AHAH) data and translating them into tangible actions for policymakers, local authorities, and communities.

**Dissemination Strategies:**

**Reports and Publications**: Detailed research reports and scholarly articles will be prepared to communicate the comprehensive findings of the study. These publications will be submitted to relevant academic journals, public health platforms, and research databases to reach a wider audience.

**Policy Briefs**: Succinct and accessible policy briefs will be developed, summarizing the key findings and recommendations of the study. These briefs are tailored to engage policymakers, government agencies, and local authorities by providing actionable insights.

**Presentations and Workshops:** The research team will present the study's outcomes at academic conferences, seminars, and workshops dedicated to public health and urban planning. These events offer opportunities to engage with researchers, practitioners, and policymakers, fostering discussions on addressing health inequalities.

**Webinars and Online Platforms**: Webinars and online platforms will be utilized to host discussions and presentations, facilitating broader access to the research outcomes. These virtual spaces encourage participation from a diverse audience, including stakeholders from different geographic regions.

**Media Engagement:** Collaborations with media outlets, both traditional and digital, will be sought to raise public awareness about health disparities and the research's implications. Interviews, op-eds, and features can amplify the research's reach beyond academic circles.

**Knowledge Translation Strategies:**

**Tailored Recommendations**: The study's recommendations will be customized to suit the distinct requirements of different regions within England, Wales, and Scotland. Policymakers and local authorities can then implement interventions that are responsive to their specific contexts.

**Collaborative Partnerships:** Engaging in partnerships with local governments, community organizations, and healthcare providers can facilitate the implementation of recommended interventions. Collaborative efforts enhance the likelihood of successfully addressing health inequalities.

**Educational Initiatives:** Creating educational resources that communicate the research findings in a user-friendly manner is vital. Workshops, training programs, and information sessions can equip stakeholders with the knowledge needed to advocate for and implement changes.

**Data Visualization**: Utilizing user-friendly and interactive data visualization tools can assist in conveying complex research findings to a wider audience. Visual representations can aid in grasping the significance of health disparities and the potential impact of interventions.

**Long-Term Monitoring:** Establishing mechanisms for ongoing data collection and monitoring can track the progress of implemented interventions. Long-term monitoring ensures that policies remain relevant and effective over time.

In conclusion, the dissemination and knowledge translation strategies outlined in this section aim to bridge the gap between research findings and practical implementation. By employing diverse communication channels and tailoring recommendations to specific contexts, the research strives to effect positive change in policies, services, and overall health outcomes for residents in England, Wales, and Scotland. [28]

**Conclusions**

In this dynamic exploration of the complex relationship between urban living conditions and the health and wellbeing of inhabitants in England, Wales, and Scotland, we have unveiled a tapestry of factors influencing urban health outcomes. Spanning ecological, societal, and economic domains, our research illuminates the intricate matrix of urban health disparities and underscores the pressing need for transformative action in urban planning and policy.

Comprehensive Perspective and All-Encompassing Approach: The urgency of embracing a comprehensive perspective cannot be overstated. The amalgamation of factors shaping urban health necessitates an all-encompassing approach that transcends conventional boundaries. Our research has meticulously identified actionable steps, rooted in empirical evidence, which possess the potential not only to bridge the chasm in health disparities but also to cultivate an environment of inclusiveness and wellness for every urban dweller.

Placing Residents' Health at the Forefront: As the narrative of urban development unfolds, the primacy of prioritizing residents' health becomes unequivocal. The trajectory of a city's development ultimately determines its destiny. To guide this expedition, empirical policies are indispensable, as they lay the cornerstone for a healthier future. The essence of this endeavor lies in uniting collective efforts, harmonizing a diverse array of stakeholders, from policymakers and healthcare providers to community leaders and citizens themselves. By fostering this harmonious synergy, urban landscapes stand poised to transform into nurturing enclaves that champion the physical, psychological, and communal welfare of their populace.

A Call to Action and a Route of Remedies: This research odyssey not only elucidates the quandaries casting shadows upon urban health but also illuminates a route of remedies. It stands as an impassioned summons for cities to harness their potential as crucibles of innovation and empathy. By embracing the insights gleaned from this scholarly voyage and embodying an unwavering dedication to healthier urban realms, we lay the groundwork for a future wherein urban existence seamlessly intertwines with flourishing health, dynamic communities, and limitless opportunities.

Bridging the Gap from Research to Action: Our dissemination and knowledge translation strategies serve as the bridge from research findings to practical implementation. Through diverse communication channels and tailored recommendations, our research endeavors to effect positive change in policies, services, and overall health outcomes for residents in England, Wales, and Scotland.

Innovative Solutions for Health Equity: The recommendations proposed herein represent innovative solutions to address urban health disparities comprehensively. By enhancing green spaces, reducing pollution, improving access to healthy food, fostering social interaction, ensuring equitable healthcare access, implementing long-term monitoring, encouraging collaboration and innovation, and promoting education and advocacy, we pave the way for a brighter urban future.

A Transformative Saga: In these concluding reflections, we do not perceive an endpoint but rather the overture to a transformative saga. It is an era of constructing healthier cities for the generations that lie ahead, marked by resilience, inclusivity, and an unwavering commitment to the prosperity and health of urban residents.

The research project stands as a testament to the power of knowledge, the potential of collaboration, and the promise of healthier cities but before all the an opportunity to better equality form a social and health aspect. It is our fervent hope that this work inspires action, informs policy, and leads to the realization of urban environments where health and well-being are not mere aspirations but living realities, need to be meant to ensure that we are going in the right trajectory.

**Recommendations**

Based on the comprehensive analysis conducted in this research paper, a set of multifaceted recommendations is proposed to address the complex challenges affecting the health and wellbeing of urban residents in England, Wales, and Scotland. These recommendations aim to create a healthier and more sustainable urban environment for all citizens by addressing the different key aspects of the urban landscape and the factors influencing health outcomes that we need to negate.

1. Enhance Green Spaces and Reduce Pollution:

Local authorities should prioritize the creation and maintenance of green spaces, including parks, community gardens, and recreational areas, in urban settings. Simultaneously, measures to reduce air pollution, such as promoting public transportation, transitioning to cleaner energy sources, and implementing stringent industrial emissions regulations, should be enacted, and strictly enforced.

The positive correlation between green spaces and health outcomes, as highlighted in this study, emphasizes the importance of accessible and well-maintained green areas in urban environments. Reducing air pollution is equally vital, as it directly impacts respiratory health and overall well-being.

2. Improve Access to Healthy Food:

Policymakers should implement strategies to encourage the establishment of grocery stores and markets that offer fresh and healthy food choices, especially in underserved neighborhoods. Tax incentives or zoning regulations can be used to limit the concentration of fast-food establishments and encourage healthier eating habits.

This recommendation aligns with the findings of this research, which underline the significance of easy access to nutritious food in combating obesity and improving overall health. By reducing the density of fast-food outlets and promoting healthy food options, urban residents can make better dietary choices.

3. Foster Social Interaction and Cohesion:

Local governments and community organizations should collaborate to develop and maintain community programs, events, and public spaces that promote social interaction. Initiatives such as community centers, regular local events, and cultural gatherings can foster a sense of belonging and social cohesion.

The social isolation can have detrimental effects on mental health, as highlighted in this study. Promoting social interaction and community engagement can mitigate these negative impacts and enhance the overall well-being of urban residents.

4. Improve Healthcare Access:

We need to address unequal access to healthcare services by investing in healthcare infrastructure in areas with high chronic disease rates. This includes expanding primary care facilities, specialist clinics, and mobile health services to provide convenient and accessible care to underserved populations.

The unequal access to healthcare services contributes significantly to health disparities among urban residents. Ensuring equitable access to quality healthcare is essential for disease prevention and timely treatment, as emphasized in this research.

5. Implement Long-Term Monitoring:

Established mechanisms for ongoing data collection and monitoring to track the progress of implemented interventions. This includes regularly evaluating the effectiveness of policies and interventions to ensure they remain relevant and continue to address emerging health disparities.

Long-term monitoring is essential to assess the sustainability and impact of policies and interventions aimed at reducing health inequalities. By continuously collecting and analyzing data, policymakers can make informed decisions and adapt strategies as needed.

6. Encourage Innovation and Collaboration:

Encourage innovation in urban planning, healthcare delivery, and community engagement by fostering collaborations between various stakeholders, including policymakers, healthcare providers, community leaders, researchers, and citizens. Create platforms for interdisciplinary collaboration to generate fresh ideas and holistic solutions.

Rationale: Innovation and collaboration are essential for addressing the complex and interconnected factors influencing urban health. By bringing together diverse perspectives and expertise, cities can develop creative and effective strategies for improving the health and well-being of their residents.

7. Promote Education and Advocacy:

The development and disseminate educational resources that communicate the research findings in a user-friendly manner. Conduct workshops, training programs, and information sessions to empower stakeholders with the knowledge and skills needed to advocate for and implement changes that promote health equity.

Education and advocacy play a crucial role in raising awareness about health disparities and mobilizing communities for positive change. Empowering stakeholders with information and resources enhances their capacity to drive meaningful improvements in urban health.

In conclusion, these recommendations, grounded in the findings of this research, provide a holistic and actionable framework for addressing urban health disparities in England, Wales, and Scotland. By implementing these strategies, urban areas can move closer to becoming inclusive, healthier, and more sustainable environments for all residents, thereby fulfilling the vision of healthier cities for generations to come.

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